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| Applicant | : | Michel Puech | |
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DECLARATION UNDER 37 CFR 1.132

**DECLARATION OF MICHEL PUECH**

I, Michel Puech, hereby declare that:

1. I am a citizen of France, and am currently a resident of Metz-Tessy, France.
2. I have extensive knowledge in the field of plasma etching, having worked for over 20 years in the industry, mainly at Alcatel in Annecy France. I am the author of over 50 papers, including a number of technical papers on plasma etching processes. I am also the holder of over ten patents on DRIE for silicon substrate etching.
3. I am presently employed by Alcatel Vacuum Technology France, a company that spearheaded much of the early development in DRIE deep silicon etching equipment. Alcatel DRIE equipment is used in semiconductor fabrication facilities around the world. Tegal Corporation is the assignee of the subject patent application and the Alcatel's AMMS DRIE product line.
4. While at AMMS, a subsidiary of Alcatel Vacuum Technology France, I oversaw the design and testing of DRIE plasma etching systems, including the technical investigation of system and process performances, setting up new measurement and data collection programs to isolate yield and reliability mechanisms, among other developments.
5. I have supervised the design of the DRIE plasma etching system for deep silicon etching at AMMS for over 15 years, and as part of my activities in designing the

DRIE plasma etching system, I have tried to improve system throughput. System throughput is a measure of the success of our DRIE plasma system, and a higher throughput means that more substrates are successfully processed in a given period, including downtime caused by maintenance.

6. One particular problem for DRIE plasma systems is process drift, which have caused significant throughput loss for many years. Prior to the present invention, process drift defects caused the etch rate of DRIE plasma etch processes to decrease progressively over time, resulting in lower throughput, either by longer substrate etch time or more maintenance times. For example, in a given etch reactor with constant process conditions, the etch rate diminishes from 10 μm/minute to 6 μm/minute after 12 hours of operation.

7. In 1999, Alcatel Vacuum Technology France was engaged in improving production throughput for deep silicon etching in DRIE plasma etch systems. At that time, we were focused largely on variations in the etch process conditions of the multistep etch/deposition process.

8. For about one year of research and development in this effort, we had performed many experiments to isolate the cause of the deterioration of the etch rate and to find a solution to the throughput loss problem, all without much progress in stabilizing the etch rate of the deep silicon alternate etching process. For example, we tested ceramic heated liners, which are used in some etch reactors. We found that these liners exhibited reductions in etch efficiency together with potential substrate contamination in deep silicon alternate etch processes.

9. It was not obvious to us, and others at the time that the etch rate degradation in deep silicon etching processes could be caused by the coupling of the etch steps and the passivation steps in the alternate deep silicon etching.

10. Only after investigating a number of potential etch parameters that were deemed to be candidates that might influence the etch portion of the alternating DRIE processes did we begin to experiment with non-etch related steps, namely the conditions in the passivation steps to determine their influence on the overall stability of the throughput of the system. We examined, among other things, the possible interference of passivating steps on the overall etch rate of the systems.

For example, we explored the concept of a heated metal liner, which had sometimes been used in deposition reactors to provide an isothermal deposition environment for cold wall deposition reactors. These further experiments took additional years of development.

11. During the investigations into the overall etch process, including examining the influence of the etch steps on the passivating steps, we found that the stability of the deposition of molecular fragments from the source gas, along with the by-products of the etch step did in fact play a significant role in causing changes in the stability of the etch rate and throughput of the system, leading to a degradation of average etch rate of the system over time.

12. After identifying possible causes for etch rate degradation, we started exploring solutions. One solution, which is disclosed in this patent application, includes lining the plasma diffusion zone of the etch chamber with a metal heated liner. In contrast to isothermal heating in a deposition reactor, this metal heated liner was restricted to the plasma diffusion zone, thus reducing the energy required to heat the part to the required temperature and providing for safe operation of the equipment providing protection for operators in the vicinity of the reactors. This solution works well and we were able to essentially stabilize the etch rate in our DRIE plasma reactor for deep silicon alternate etch processes.

13. This invention took multiple years to develop and was not at all obvious, in my opinion.

I hereby declare that all statements made herein of my own knowledge are true, and that all statements made on information and belief that are believed to be true; and further, that these statements were made with the knowledge that willful false statements and the like are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the above-identified application or any patent issued thereon.

Executed on Jan 10th 2011 at ANNECY

By Michel Puech

Michel Puech